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UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

EXPLORATION OF A NICKEL-COPPER-COBALT DEPOSIT AT FUNTER BAY, ADMIRALTY ISLAND, ALASKA

BY

STEPHEN P. HOLT AND JOEL M. MOSS

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By Stephen P. Holt[2] and Joel M. Moss[3]

CONTENTS

INTRODUCTION

Nickel is one of the seven metals designated as strategic by the Army and Navy Munitions Board in 1939, when Congress appropriated funds for the investigation of domestic sources of supply of war minerals. The Mertie nickel lode at Funter Bay, Admiralty Island, Alaska, owned by the Admiralty Alaska Gold Mining Co., was investigated as part of this program.

During the period 1919 to 1928, the property was examined by the following engineers: L. S. Robe, W. E. Dunkle, and S. B. Combest of the Alaska Treadwell Co., A. F. Buddington of the Federal Geological Survey, and H. C. Boydell. Henry M. Eakin, in the capacity of consulting geologist, examined

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 3950."

2/ Mining engineer, Bureau of Mines, Juneau, Alaska.

3/ Mining engineer, Bureau of Mines, Juneau, Alaska.

the deposit in 1928 and later reviewed data resulting from exploration recommended by him. In 1936, A. Hoegbom, of the Geological Survey of Sweden, made a very brief report on the deposit based upon information furnished by W. S. Pekovich.

A comprehensive study by the Geological Survey of the Funter Bay area, including the Mertie lode, was made during the field season of 1937, with brief examinations in 1936 and 1938.4/

Miyaki, representing the Mitsubishi Company, visited the property in 1937 and in the course of his examination took six samples. G. W. Pawel examined the deposit in 1937 and took five samples in the Mertie adit.

This report describes the results of the Bureau's work and gives information collected from other sources.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary objective the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practicable after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests. Both these branches are under the supervision of Dr. R. S. Dean, assistant director.

Special acknowledgment is due W. S. Pekovich, manager, Admiralty Alaska Gold Mining Co., for making available his data. Acknowledgment is also due to Robert S. Sanford, acting chief, Alaska Division, Mining Branch, for his help in revising this report and supervising the project work. The Rolla Division metallurgical staff, C. Travis Anderson, chief, analyzed the samples and made the beneficiation tests.

LOCATION AND ACCESSIBILITY

The property is in the Admiralty Mining District at longitude 134° 51' 30" W., latitude 58° 14' 15" N. It is on the south side of Funter Bay along the west coast of Mansfield Peninsula, which forms the northern extremity of Admiralty Island. The location is shown on figure 1.

Funter Bay is 18 miles west of Juneau by airline, 55 miles by boat, and is adjacent to a coastwise steamship lane. The bay is well-protected and has a harbor suitable for boats of any size. At present, large boats have to dock across the bay at the cannery. The old dock at the Admiralty-Alaska beach camp is in complete disrepair. The dock could be rebuilt, as there is deep water and good bottom for piling close to shore.

4/ Reed, John C., Nickel-Copper Deposit at Funter Bay, Admiralty Island, Alaska: Geol. Surv. Bull. 936-O, 1942.

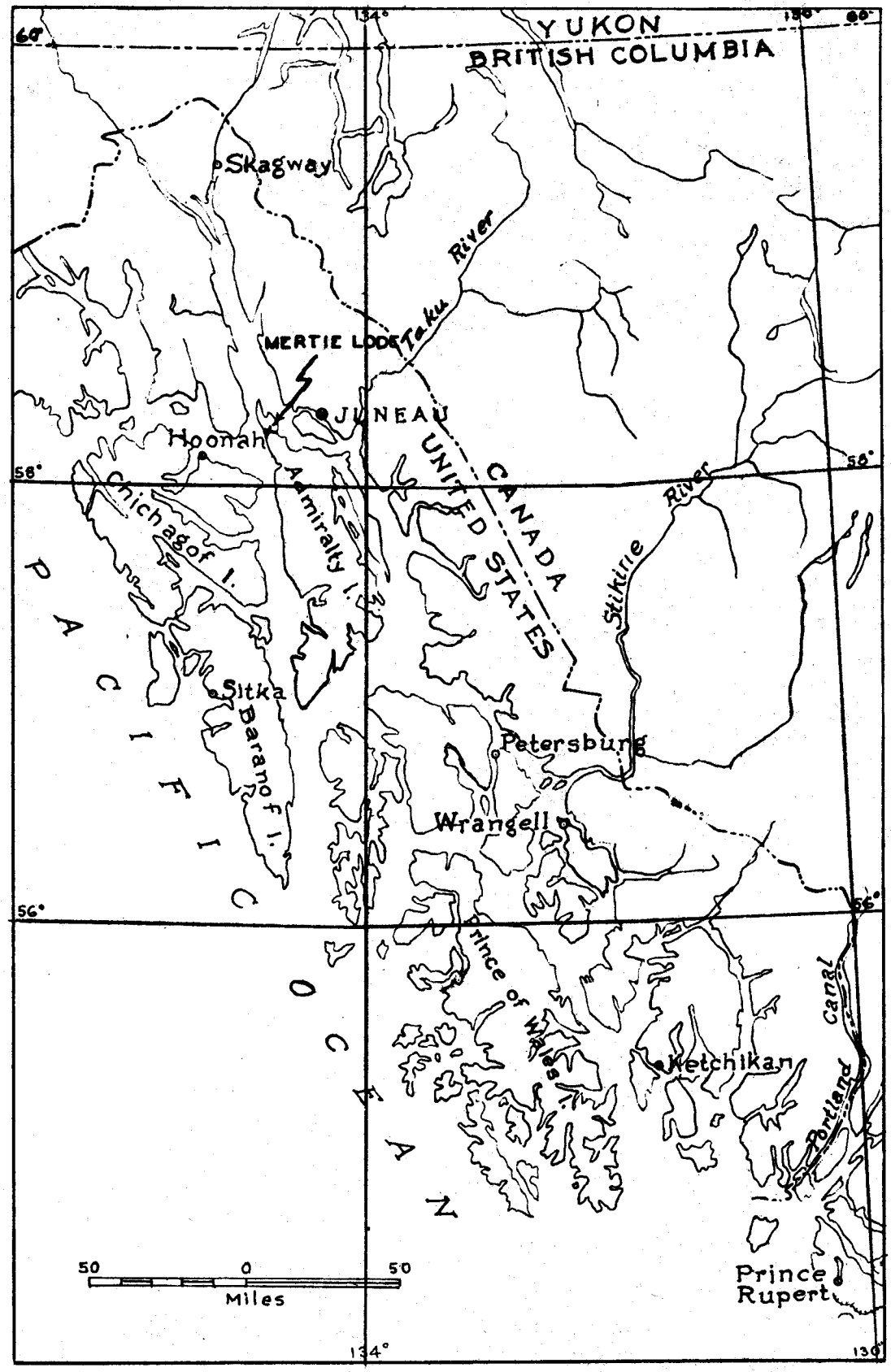


FIG. 1 – INDEX MAP, SOUTHEASTERN ALASKA

PHYSICAL FEATURES AND CLIMATE

Admiralty is one of the larger islands of Southeastern Alaska. Its maximum dimensions slightly exceed 90 by 20 miles. Inland channels between the islands and the mainland as well as between the islands themselves are the result of glacial action, which is also reflected in the topography of the land area. Robert Barron Peak, just back of Funter Bay, is an elongated mass thar rises abruptly from a nearly flat bench of glacial moraine to an altitude of more than 3,000 feet.

The area is covered with a virgin stand of hemlock and spruce with diameters as great as 2 feet. Because of the trees, the underbrush of salmonberry and devil club is not dense except where heavy slides have occurred.

Occasional outcrops of rock occur below 1,800 feet, but most of the mountainside is covered by talus.

The climate in the Funter Bay area is similar to that of Juneau, where annual precipitation averages 83 inches, including 109 inches of snow. The mean annual temperature over a period of 43 years is 42.1° F. At sea level the temperature seldom drops to 0° F. in the winter, and snow rarely remains long except at high elevations. Year-around mining can be done.

HISTORY AND PRODUCTION

The Admiralty-Alaska Gold Mining Co. acquired the property as a lode-gold prospect in 1918. The Mertie nickel-copper lode was discovered in 1919 and named for J. B. Mertie, Jr., of the Federal Geological Survey, one of the discoverers.

Henry M. Eakin, consulting geologist, was engaged by the company to investigate both the gold and the nickel-copper potentialities of the property. As a result of his examination, the Mertie lode was explored by 9 diamond-drill holes and a 126-foot crosscut adit. The material produced in driving the adit was used in mill tests, and the concentrates obtained were utilized in smelter tests.

The gold lodes have been explored extensively by drifting, core drilling, and sinking. Some ore has been mined, part of which was beneficiated at a small mill on the property.

ORE DEPOSITS

General Geology

The following has been excerpted from Reed's[5] report on the geology of the area:

5/ Work cited in footnote 4.

The country around Funter Bay is underlain by a thick sequence of metamorphic rocks. The age of these rocks is not definitely known, but on a map compiled by Buddington and Chapin they are designated as "Paleozoic sediments and volcanics." The sequence includes both sedimentary and igneous rocks, the latter being partly extrusive and partly intrusive types. All these rocks have undergone intense dynamic and igneous metamorphism, by which their original characteristics have been largely obscured or obliterated.

The phyllite and the greenstone are in part interbedded, and some layers of both are discontinuous. Much of the discontinuity appears to be due to structural movements, but it is doubtless due in part to differences in original discontinuities of the strata and the intrusive bodies.

A basic sill and several dikes of widely varied composition were intruded into metamorphic rocks after the metamorphism took place, being themselves unaffected by shearing or other drastic alteration. The relations of the dikes to the sill are unknown and, being of no economic importance, they will not be described and are not mapped. The sill, on the contrary, is of economic importance, for it constitutes the nickeliferous deposit.

Occurrence of the Deposit

The deposit outcrops at an elevation of 1,700 feet on the western slope of Robert Barron Peak. It has been variously described as a troctolite or olivine diabase dike,[6] a basic sill,[7] and as a gabbro.[8] Work by the Bureau of Mines indicates the ore deposit may be in the form of a pipe.

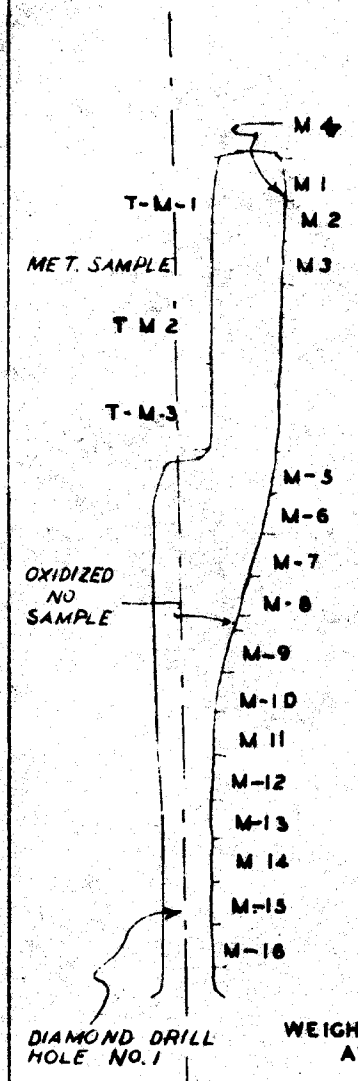
Similar rock is reported to occur at intervals for several thousand feet along a projected generally north-south strike. These reported outcrops have not been investigated nor their existence confirmed. The deposit has an undetermined easterly dip. Whether this pipe is mineralized throughout or in localizations within the intrusives is not known.

Character of Ore

The following is quoted from an undergraduate thesis:[9]

The metallic minerals are, in order of their abundance, pyrrhotite, pentalandite, chalcopyrite, magnetite, pyrite, and sphalerite. The sulphides occur as small blebs of irregular

6/ Buddington, A. F., and Chapin, Theodore, Geology and Mineral Deposits of Southeastern Alaska: Geol. Surv. Bull. 800, 1929, p. 348.
7/ Work cited in footnote 4.
8/ Bureau of Mines (Rolla Station), Metallurgical Report on the Mertie lode: Unpublished report.
9/ Worcester, John, Examination of and Flotation Experiments on a Nickel Ore from Alaska: Massachusetts Institute of Technology, 1930.



SAMPLE	PERCENT NI	CU	CO	OUNCES AU	AG
T M 1	.34	.24	∠.1		
T-M-2	.33	.35	∠.1		
T-M-3	.31	.26	∠.1		
M-1	.40	.35	.05	∠.005	.04
M-2	.28	.40	.22	∠.005	.03
M3	.41	.40		.01	1.10
M 4	.31	.13	SPECIAL OXIDIZED SAMPLE		
M-5	.69	.57	.23	∠.01	.02
M-6	.86	.53	.17	∠.01	.05
M-7	.38	.35		-	20
M-8	.39	.66	.17	.03	.20
M-9	.78	.43	.09	.01	.20
M-11	.64	.58		.01	4.0
M-10	.67	.43		.02	.80
M-12	.45	.40		—	.60
M 13	.56	.58		.01	.40
M 14	.48	.48		—	1.10
M-15	.22	.33		—	.90
M-16	.30	.20		—	.60
MET.	.26	.30	.07		
WEIGHTED AVERAGE	.48	.41	.13	∠.01	043

SCALE IN FEET
0 10 20 30 40 50

CHANNEL SAMPLES CUT HORIZONTAL BETWEEN INDICATED LIMITS

FIG. 2-MERTIE LODE SAMPLE MAP

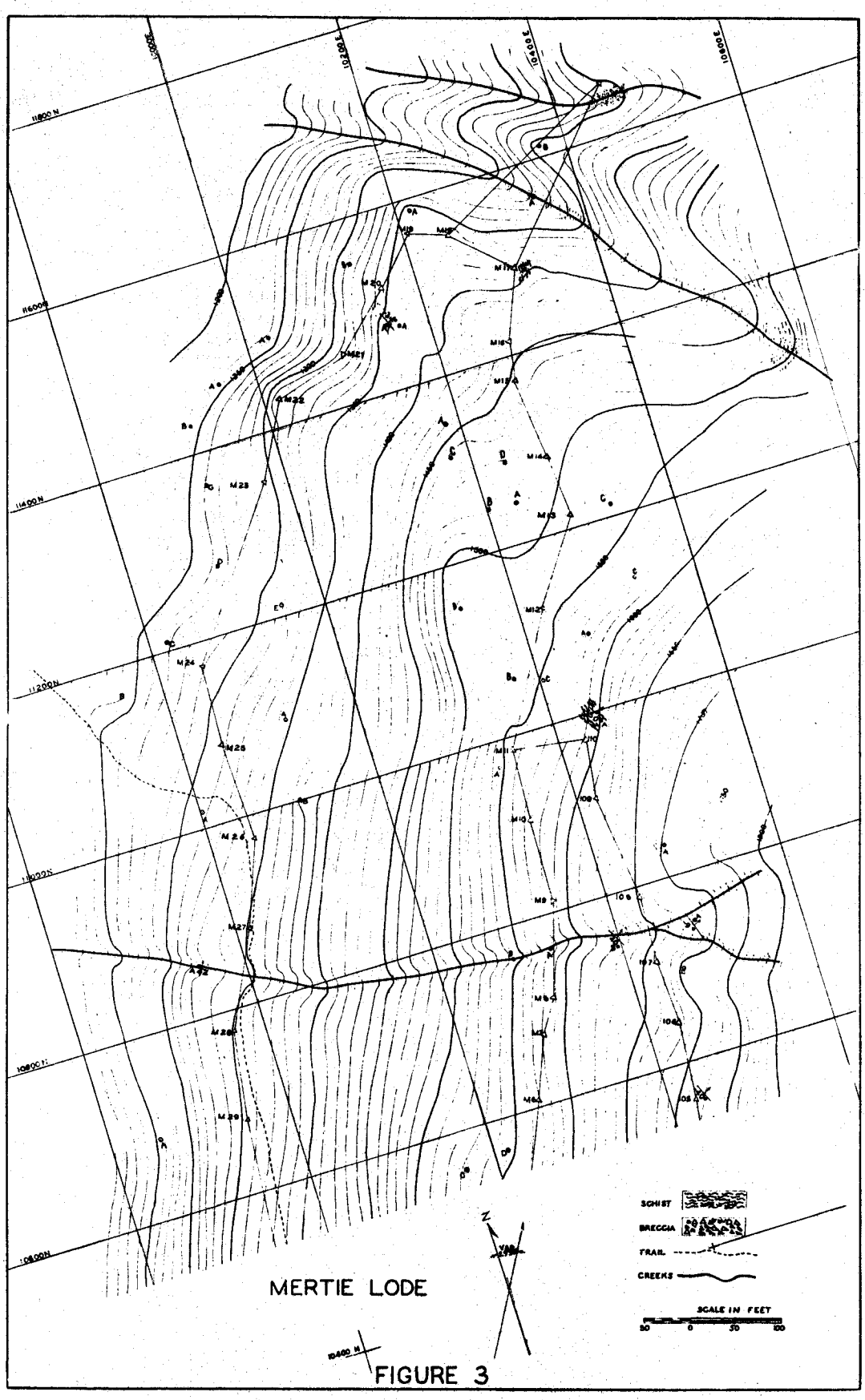

MERTIE LODE
SCHIST
BRECCIA
TRAIL
CREEKS
SCALE IN FEET
50 0 50 100

FIGURE 3

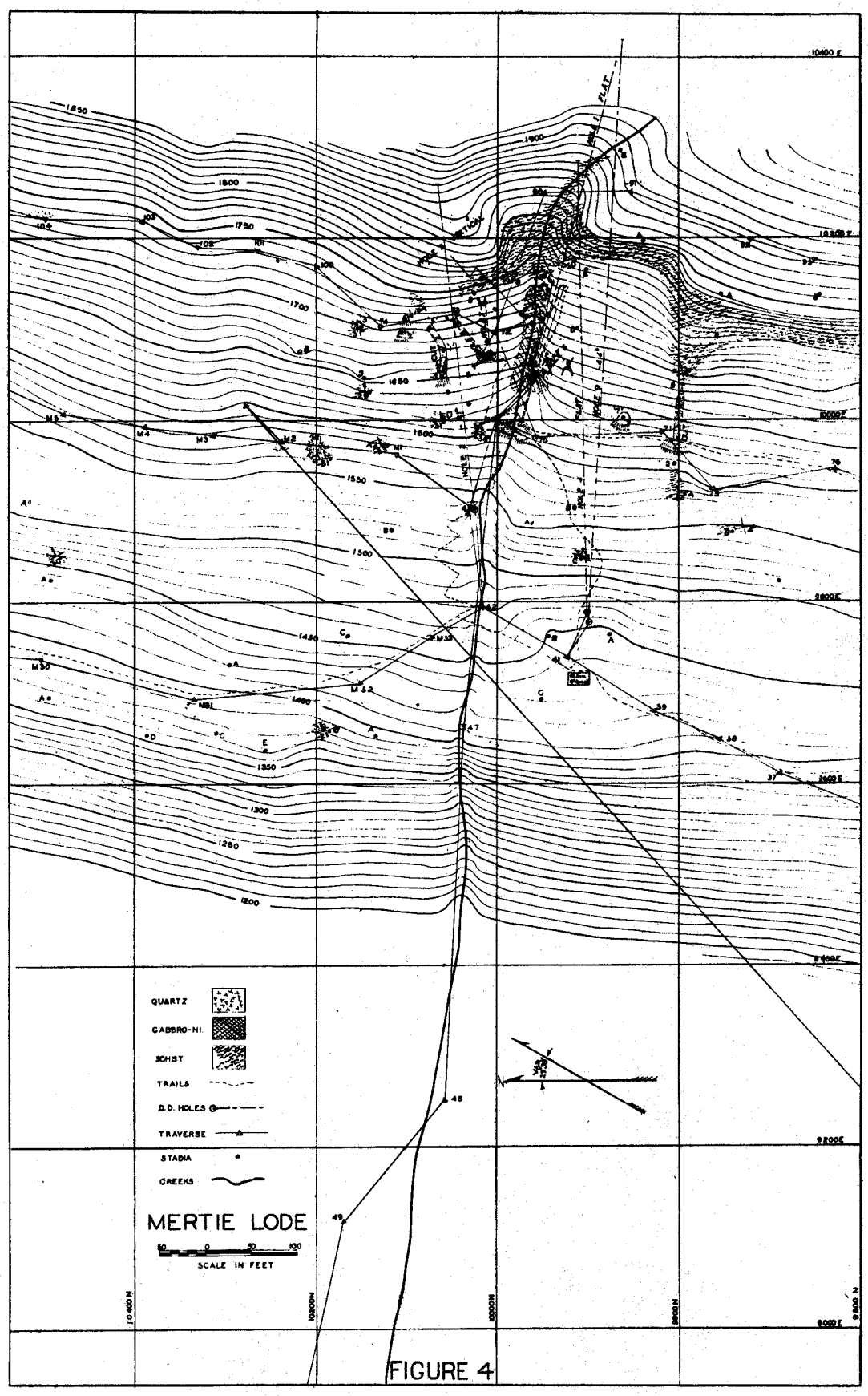

QUARTZ
GABBRO-NI.
SCHIST
TRAILS
D.D. HOLES
TRAVERSE
STADIA
CREEKS
MERTIE LODE
50 0 50 100
SCALE IN FEET
10400 E
10200 E
10000 E
9800 E
9600 E
9400 E
9200 E
9000 E
10400 N
10200 N
10000 N
9800 N
9600 N
FLAT
VERTICAL
1850
1800
1750
1700
1650
1600
1550
1500
1450
1400
1350
1300
1250
1200

FIGURE 4

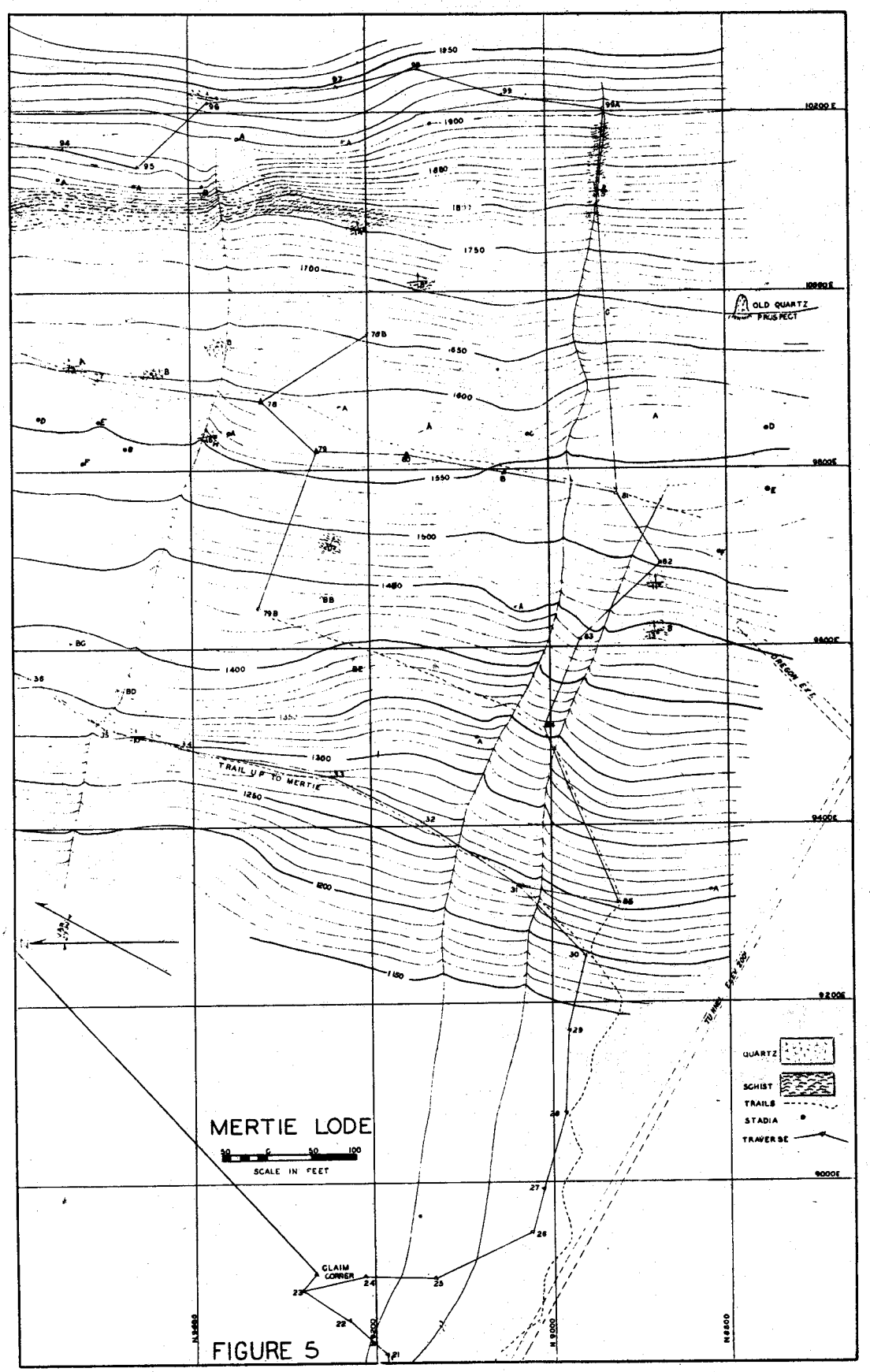
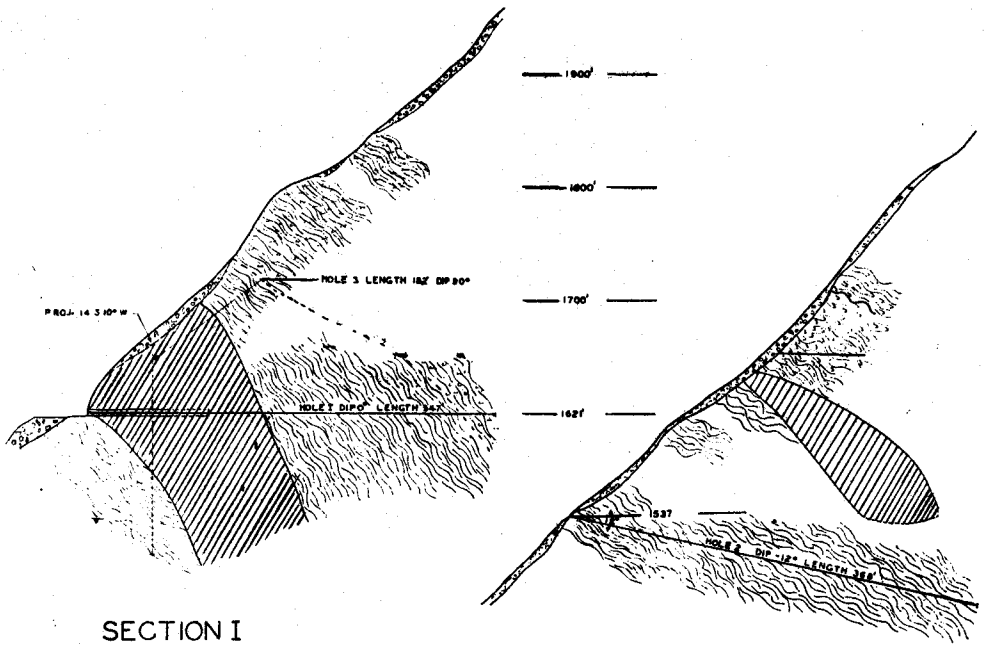

MERTIE LODE
SCALE IN FEET
OLD QUARTZ PROSPECT
TRAIL UP TO MERTIE
CLAIM CORNER
QUARTZ
SCHIST
TRAILS
STADIA
TRAVERSE
10200 E
10000 E
9800 E
9600 E
9400 E
9200 E
9000 E
N 9200
N 9000
N 8800

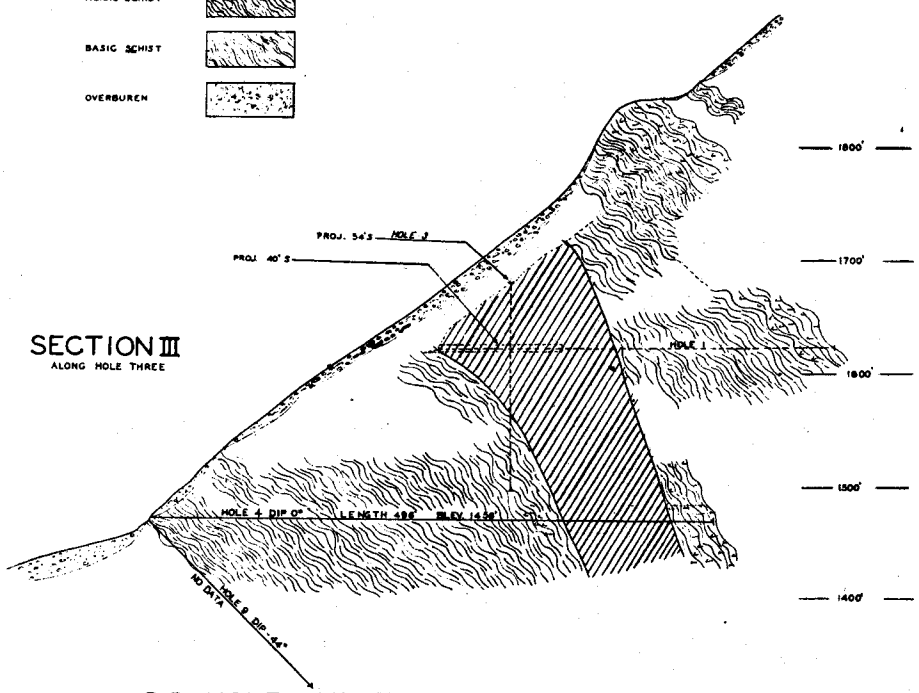
FIGURE 5



SECTION I
ALONG HOLE ONE

SECTON II
ALONG. HOLE TWO

GABBRO-NI.
ACIDIC SCHIST
BASIC SCHIST
OVERBUREN



SECTION III
ALONG HOLE THREE

D.D. HOLE SECTIONS OF MERTIE LODE

50 0 50 100
SCALE IN FEET

FIGURE 6

size and shape, ranging from the smallest specks seen with high magnification up to masses an inch in diameter. They have no particular orientation in the rock, but are scattered throughout quite uniformly. They are distinctly interstitial to rock-forming minerals. The larger masses contain the bulk of the pyrrhotite, while the smaller specks are predominantly composed of chalcopyrite.

The physical character of the ore as determined by the Bureau of Mines shows that it occurs as a gabbro containing an appreciable amount of nickeliferous pyrrhotite and smaller amounts of chalcopyrite, pyrite, and violarite, $(Ni, Fe)_3S_4$. The chalcopyrite, violarite, and pyrrhotite usually are intimately locked. Some free violarite was noted in the polished sections in areas 0.5 mm. and less in diameter. Most of it however, was associated with chalcopyrite as micro-stringers in the pyrrhotite. Many of these stringers penetrated into the fractures in the country rock. Most of the chalcopyrite occurs at the periphery of the pyrrhotite areas and often fingers into them. The country rock is a dark-gray gabbro consisting predominately of the calcic plagioclase, labradorite, augite, and a small amount of olivine. Grinding through 200-mesh is necessary for liberation of most of the chalcopyrite and violarite.

EXPLORATION AND SAMPLING

A complete record of exploration of the Mertie Lode is not available. Data herein employed have been taken from the following:

1. An assay map covering core drilling by the Admiralty-Alaska Gold Mining Co.;

2. Correspondence and miscellaneous records submitted by W. S. Pekovich, manager of that company;

3. Results of sampling in the Mertie adit, surface trenching, and mapping by engineers of the Bureau of Mines.

The locations, elevations, bearings, and inclinations of all core-drill holes were surveyed and plotted on the topographic map made by the Bureau. (See figs. 3-6.)

Hole 1, at an altitude of 1,621.0 feet, was advanced horizontally from the footwall of the pipe, and the hanging-wall contact was encountered at 184 feet. Analyses of this core in 10-foot sections, reported by the company, indicate that a horizontal width of 150 feet contains an average of 0.74 percent nickel and 0.27 percent copper. It has been reported by W. S. Pekovich, manager of the Admiralty-Alaska Gold Mining Co., that a composite of 10 samples of core from this drill hole contained 0.215 percent cobalt and 0.68 percent nickel.

Hole 2, 180 feet northeast of hole 1 and at an altitude of 1,537.6 feet, has been directed N. 83° 15' E. at an inclination of -12°. It stopped in broken material at a depth of 360 feet without having encountered the ore body.

Hole 3 was collared within the ore body at a point 70 feet northeast of hole 1 and was drilled vertically. The initial 30 feet is reported to have penetrated oxidized material, and the next 120 feet of gabbro included a 50-foot section averaging 0.68 percent nickel and 0.25 percent copper.

Hole 4 is 270 feet southwest of hole 1 and, as mapped, is approximately normal to the pipe which it cuts at an altitude of 1,457.8 feet. A 130-foot section within the mass is reported to have an average nickel content of 0.91 percent and an average copper content of 0.21 percent. A central section 40 feet long is reported to contain 1.90 percent nickel and 0.25 percent copper.

The section of higher-grade ore occurring in the central portion of the pipe, as indicated by analyses reported by the Admiralty-Alaska Gold Mining Co., is shown in table 1.

Table 2 shows the analyses from Admiralty-Alaska Gold Mining Co. for drill holes 1, 3, and 4.

Holes 5 and 6 are at the footwall of the outcrop where hole 1 is collared. No. 5 bears S. 73° 49' E. at an inclination of -46°. Hole 6 bears S. 52° 33' E. at an inclination of -21°. No data on these holes are available.

Holes 7 and 8 are collared in the Mertie Lode outcrop 55 feet northeast of hole 1 and at an altitude of 1,663 feet. Hole 7 has a bearing of N. 49° 27' E. at an inclination of -44°. Hole 8 has a bearing of N. 84° 36' E. at an inclination of -9° east. There are no available data on these holes.

Hole 9, in the same locality as hole 4, has a bearing S. 87° 17' E. at an inclination of -44°. No data on this hole are available.

The only mine opening that has penetrated the deposit is the Mertie adit, which coincides with the first 95 feet of drill hole 1. It is believed to have been driven in 1930, and no record exists of the degree of leaching then in evidence. When sampled by the Bureau in October 1943, a considerable amount of oxidized material was noted. A description of the samples taken is given in table 2 and the results of analyses are shown on figure 2. The alternate flooding and draining of the adit known to have occurred over a period of about 13 years may have accelerated the rate of oxidation.

In the spring of 1942, the lode was sampled by George Gates, geologist of the Federal Geological Survey at which time one horizontal chip sample and five light vertical-channel samples were obtained. The individual samples closely approximated samples cut later in corresponding areas by the Bureau of Mines. Sampling by the Geological Survey does not extend throughout the length of the adit, and the orientation and location of their sample cuts do not permit calculation of average grade over any substantial section.

A sample was obtained by the Bureau of Mines in 1942 for the purpose of determining amenability to treatment and the association of nickel with primary minerals of the rock. Accordingly, a sample site was selected that showed the least alteration and that also proved to be of lowest grade.

Three horizontal channel samples also cut at this time were each 10 feet long and adjacent to the metallurgical sample. Sixteen horizontal channel samples taken in 1943 along the south wall completed the sampling of that portion of the lode exposed in the Mertie adit. Figure 2 shows the location and analyses of the samples.

TABLE 1. - Admiralty-Alaska drill-hole analyses. Measurements from footwall to hanging wall on hole 1 and 4, and from the surface on hole 3

Approximate distance, feet	Drill hole 1, analysis, percent		Drill hole 3, analysis, percent		Drill hole 4, analysis, percent	
	Ni	Cu	Ni	Cu	Ni	Cu
0-10	0.42	0.87			0.02	Trace
10-20	.68	.49			.34	0.27
20-30	.63	.36			.51	.24
30-40	.53	.49	0.06	0.05	.60	.12
40-50	1.03	.19	None	.06	.30	.31
50-60	.98	.14	0.43	.42	2.71	.19
60-70	1.08	.19	.31	.24	2.50	.41
70-80	.66	Trace	1.27	.21	1.33	.39
80-90	.98	0.24	.99	.28	1.06	Trace
90-100	.54	.22	.41	.08	Trace	0.10
100-110	1.17	.17	Trace	Trace	0.97	.10
110-120	.36	.17	Trace	0.03	.45	.19
120-130	.77	.14	Trace	Trace	.66	.29
130-140	.54	.19	None	0.03	.35	.19
140-150	.68	.14	Trace	.08	None	Trace
150-160	.17	.12				
160-170	Trace	.10				
170-180	0.11	.12				
180-190	.11	.07				
190-200	.18	.05				
200-210	.06	.05				

Central higher-grade sections of Mertie Lode, taken from table 1

Hole	Section length, ft.	Section location	Percent nickel	Percent copper
1	70	40 to 110 feet from footwall	0.92	0.16
3	20	70 to 90 feet from footwall	1.13	.24
4	40	50 to 90 feet from footwall	1.90	.25

TABLE 2. - Description of Bureau of Mines Samples from Mertie Lode, October 1943

Sample	Location, feet west of face	Notes
M-1 ...	1 to 6	3.5 feet above floor.
M-2 ...	6 to 11	4.0 feet above floor.
M-3 ...	11 to 16	4.5 feet above floor.
M-4 ...	4.5	Special sample oxidized streak, limonite and altered gabbro.
M-5 ...	36 to 41	4.3 feet above floor.
M-6 ...	41 to 46	4.7 feet above floor, 1.5 feet oxidized, limonite.
M-7 ...	46 to 51	4.5 feet above floor, some limonite streaks.
M-8 ...	51 to 56	4.5 feet above floor. Includes 1 foot opening, result of oxidation.
M-9 ...	56 to 61	2.0 feet above floor. Altered zone 2.5 feet soft, considerable limonite.
M-10 ..	61 to 66	2.7 feet above floor. Blocky, hard, some limonite and serpentine.
M-11 ..	66 to 71	3.0 feet above floor. Oxidized, blocky, some serpentine, 3 feet soft material.
M-12 ..	71 to 76	3.7 feet below back. Some oxidation.
M-13 ..	76 to 81	3.0 feet below back. 2/3 material oxidized.
M-14 ..	81 to 86	1.9 feet below back. Oxidized, limonite and serpentine.
M-15 ..	86 to 91	2.0 feet below back. Oxidized, limonite and serpentine.
M-16 ..	91 to 96	1.7 feet below back. Oxidized.

NOTE: Those samples without a description of the material cut were of unaltered, mineralized gabbro. The interval of 16 to 36 feet from the face had been sampled previously by the Bureau of Mines. All samples were cut horizontally and along the south wall of the adit.

In table 3, the results of sampling by the Bureau of Mines of a 90-foot section of the Mertie adit, extending to within 5 feet of its face, and analyses reported by the company of the corresponding section of core from drill hole 1 are compared.

Comparison of the above results shows that averaged analyses obtained by the Bureau of Mines exceed those reported by the Admiralty-Alaska Gold Mining Co. by 37 percent for copper and are 72 percent less for nickel.

Cobalt determinations were made on six of the above samples taken by the Bureau of Mines. They indicate that a ratio of about 3 to 1 exists between the nickel and cobalt content. A spectrographic analysis indicated that the platinum group is not present. Gold and silver in small amounts are present and amount to about $1 a ton in the samples taken by the Bureau of Mines.

TABLE 3. - Comparison of sampling results

Sample	Length, feet	Channel samples, Bureau of Mines, Percent		Core-drill hole 1, Admiralty-Alaska Co., Percent	
		Nickel	Copper	Nickel	Copper
M-16, M-15	10	0.26	0.26	0.42	0.87
M-14, M-13	10	.52	.52	.68	.49
M-12, M-11	10	.54	.49	.63	.36
M-10, M-9	10	.72	.43	.53	.49
M-8, M-7	10	.63	.50	1.03	.19
M-6, M-5	10	.52	.55	.98	.14
TM-3	10	.31	.26	1.08	.19
TM-2	10	.33	.35	.66	Trace
M-3, M-2	10	.31	.37	.98	0.24
Total	90				
Average	-	0.46	0.41	0.79	0.30

A large part of the material produced as this adit was being driven is reported to have been used by the company in pilot-mill tests and to have averaged 0.794 percent nickel and 0.767 percent copper. Subsequently, the same section was slabbed along the south wall of the adit for additional mill-test material, which is reported to have averaged 1.105 percent nickel and 1.125 percent copper.

It is believed that the available data are insufficient to permit estimation of the average nickel and copper content of the explored portion of the Mertie lode. Considerable discrepancy exists between the sampling results obtained by the Bureau of Mines and the company in the section represented by drill hole 1 and the Mertie adit. Although this is believed to preclude acceptance of analyses reported for holes 1 and 4, which constitute the only two sections to date across the lode, the existence of a low-grade nickel-copper-cobalt deposit is indicated.

It is not known from what part of the Mertie Lode the samples for the Mitsubashi Co. were taken. As shown in table 4, an arithmetical average of the six determinations is 0.46 percent copper 0.46 percent nickel, and 0.08 percent cobalt.

G. W. Pawel cut five samples from the Mertie Lode. Comparison of them with corresponding samples taken by the Bureau appears in table 5.

Results of the Bureau's sampling show close approximation in nickel content to that done by G. W. Pawel and the Mitsubashi Co.

TABLE 4. - Analyses of samples taken in Mertie adit by Miyaki of the Mitsubashi Co.

Sample	Percent copper	Percent nickel	Percent cobalt
1	0.67	0.63	0.07
2	.73	.85	.13
3	.64	.65	.11
4	.40	.21	.04
5	.18	.23	.08
6	.12	.20	.06
Averages	.46	.46	.08

TABLE 5. - Comparison between samples taken by G. W. Pawel and the Bureau of Mines, in the Mertie adit

	Pawel, percent		Bureau of Mines, percent	
Sample location, feet from face	Nickel	Copper	Nickel	Copper
0-5	.49	.37	.40	.35
5-10	.42	.25	.33	.35
65-75	.49	.43	.67	.43
80-85	.78	.72	.56	.58
90-95	.50	.60	.30	.20
Average	1/ .53	.47	.45	.38

1/ The possibility of cobalt being included in the reported nickel content is suggested.

DEVELOPMENT

The Mertie Lode was developed by 9 diamond-drill holes and a 126-foot crosscut adit, the last 95 feet of which penetrates the nickel deposit. Several of these holes are reported to have penetrated the lode, in the vicinity of the discovery, for all or part of their length but no cores or analyses are available.

At an altitude of 200 feet, an adit designed to develop gold veins penetrates Robert Barron Peak in a S. 59° E. direction a distance of 2,600 feet. The portal of this adit is slightly south and about 2,400 feet west of the Mertie Lode discovery. Pekovich states that from a point 1,200 feet inside the adit, a diamond-drill hole was advanced 1,500 feet toward the vertical projection of the Mertie Lode and for financial reasons was stopped at least 500 feet short of its objective. A parallel hole is reported to have been drilled from a point about 2,400 feet from the portal and was considered to have reached the lode after having been advanced about 1,300 feet. A water course was encountered at that depth, after which the hole was continued a distance of 200 feet. Fragments of core from the nickel lode are reported to have been recovered, but no samples were taken.

EQUIPMENT

The following equipment is at the property:

Beneficiation plant equipped for flotation and having a rated capacity of 100 tons a day is on the beach.

Small, complete mining plant, including water-powered compressors. Buildings, ditch, and pipe line are in poor shape.

Assay office and equipment.

A large stock of hand tools and fittings.

Boarding house and numerous dwellings on the beach.

A watchman is employed, and the mill and camp are in good shape, but the ditches that served the water-powered compressors are in poor condition.

WORK DONE BY THE BUREAU OF MINES

Ninety-five feet of 3- by 1-inch channel samples were cut in the Mertie Lode adit by the Bureau of Mines, and a beneficiation sample weighing 314 pounds was sent to and reported on by the Bureau's laboratory in Rolla, Mo. A transit control survey was made of an area 3,000 feet by 1,000 feet and tied into the lower adit. This area was mapped both topographically and geologically.

The strike extent of the Mertie Lode was prospected by two open cuts and five large test pits. The cuts and three of the test pits reached bed rock through the heavy slide-rock overburden.

A slide closing the portal had to be cleared away to enable the Bureau's engineers to gain entrance to the Mertie Lode crosscut adit. Four sets of timber were replaced in the lower adit where it had been closed by a cave 1,000 feet from the portal. One hundred twenty tons of slide rock were trammed to the dump, and the rest of the adit was then mapped.

Service to the camp was greatly improved when a large float was made of logs from an abandoned fish trap and anchored off the beach in deep water. Prior to this, supplies and passengers had to embark at the cannery across the bay.

BENEFICIATION TESTS

The following report shows the results of a beneficiation test made at the Rolla laboratory on a sample of the nickel-copper ore from the property.

Physical Character:

The ore occurs as a gabbro containing an appreciable amount of nickeliferous pyrrhotite and smaller amounts of chalcopyrite, pyrite, and violarite $(Ni, FE)_3S_4$. The chalcopyrite, violarite, and pyrrhotite usually are intimately locked. Some free violarite was noted in the polished sections in areas 0.5 mm.

and less in diameter. Most of it, however, was associated with chalcopyrite as micro-stringers in the pyrrhotite. In many instances these stringers penetrated into the fractures in the country rock. Most of the chalcopyrite occurs at the periphery of the pyrrhotite areas and often fingering into them. The country rock is a dark-gray gabbro consisting predominately of the calcic plagioclase, labradorite, augite, and a small amount of olivine. Grinding through 200 mesh is necessary for the liberation of most of the chalcopyrite and violarite.

Chemical Character:

Analysis of ore, percent

Ni	Cu	Co	Pb	As	Fe	S	SiO_2
0.26	0.30	0.07	< 0.05	< 0.01	10.6	0.6	36.7

Treatment Procedure:

1. Magnetic separation
2. Bulk flotation
3. Selective flotation of copper and nickel minerals
   (a) Low-grade nickel concentrate - high recovery
   (b) High-grade nickel concentrate - low recovery

Magnetic Separation

Treatment

The ore was ground wet in stages through 150-mesh. The pulp was then diluted to about 5 percent solids and treated in ferro-filter.

Metallurgical data

Product	Weight, percent	Analysis, percent		Percent of total	
		Cu	Ni	Cu	Ni
Magnetic concentrate.	27.8	0.37	0.79	39.3	68.5
Nonmagnetic tailing..	72.2	.22	.14	60.7	31.5
Head, calculated.....	100.0	.26	.32	100.0	100.0

Bulk Flotation

Treatment

The ore was ground wet in stages through 150-mesh for flotation. After thickening to a pulp of 25 percent solids, the feed was floated and the rougher concentrate was cleaned once. Zeolite-softened water was used in grinding and flotation.

Metallurgical data

Product	Weight, percent	Analysis, percent		Percent of total	
		Cu	Ni	Cu	Ni
Concentrate	13.4	0.84	1.78	59.2	73.2
Middling	5.7	.65	.68	19.5	11.9
Tailing	80.9	.05	.06	21.3	14.9
Head, calculated ..	100.0	.19	.33	100.0	100.0

Reagent data

Reagent	Mill	Pounds per ton of feed		
		Conditioner	Rougher	Cleaner
Reagent 301[1] ..		0.3	-	-
Reagent 238[1] ..		.02	-	-
Pine oil		.16	-	-
Time, minutes ..	30	2	8	6

1/ American Cyanamid Co.

Selective Flotation of the Copper and Nickel Minerals

Low-grade Nickel Concentrate - High Recovery

Treatment

The ore was ground wet in stages through 200-mesh. The zeolite-softened water was used in grinding and flotation. The ground ore was thickened to a pulp density of 25 percent solids for flotation. Copper, nickel, and pyrrhotite rougher concentrates were floated successively in the order named. The copper and pyrrhotite concentrates were cleaned once. The copper middling was combined with the nickel concentrate.

Metallurgical data

Product	Weight Percent	Analysis, percent		Percent of total	
		Cu	Ni	Cu	Ni
Copper concentrate	1.4	18.4	1.72	79.8	6.7
Nickel concentrate	16.0	.09	1.85	4.5	82.0
Pyrrhotite concentrate..	2.2	.49	.85	3.3	6.6
Pyrrhotite middling	2.8	$<$.05	.43	.4	2.6
Tailing	77.6	$<$.05	.01	12.0	2.1
Head, calculated	100.0	.32	.36	100.0	100.0

Reagent data

Reagent	Pounds per ton of feed								
	Copper				Nickel		Pyrrhotite		
	Grind	Cond.	Rougher	Cleaner	Cond.	Rougher	Cond.	Rougher	Cleaner
Lime	7.0	-	-	-	-	-	-	-	-
Sodium ethyl..	-	-	-	-	-	-	-	-	-
Xanthate	-	0.05	-	-	-	-	-	-	-
Reagent 238 ..	-	.03	-	-	-	-	-	-	-
Cresylic acid.	-	.16	-	-	-	-	-	-	-
Sodium cyanide	-	.10	-	-	-	-	-	-	-
Potassium amyl xanthate	-	-	-	-	0.05	-	0.04	-	-
Pine oil	-	-	-	-	.16	-	-	-	-
Sulphuric acid	-	-	-	-	-	-	10.0	-	-
Time, minutes.	50	2	4	3	2	10	2	5	3

High-grade Nickel Concentrate - Low Recovery

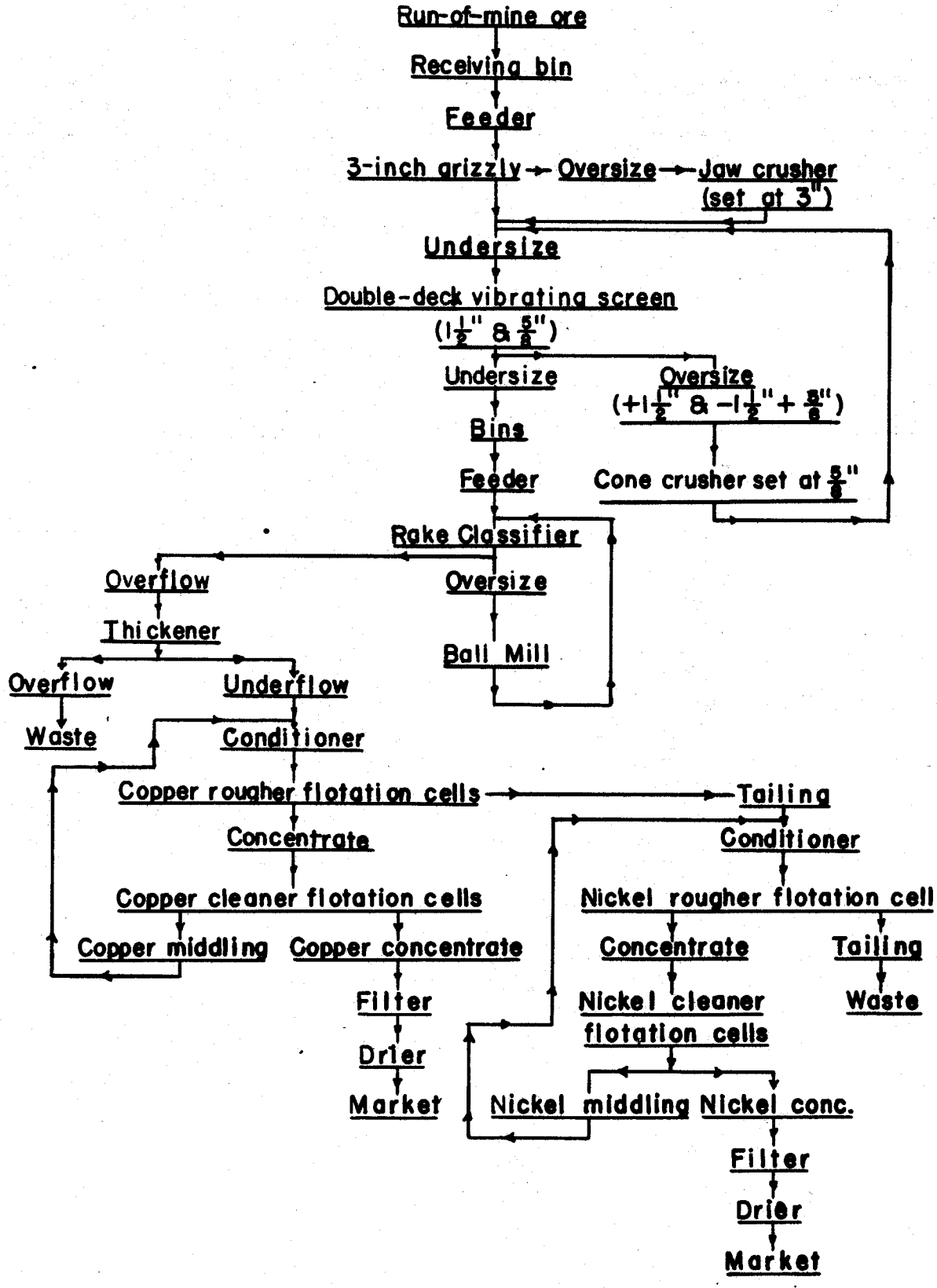
Treatment

The ore was ground wet in stages through 150-mesh. Zeolite-softened water was used in the grinding and flotation. The ground ore was thickened to a pulp density of 25 percent solids for flotation.

Copper, nickel, and pyrrhotite roughers were floated successively. Each of the rougher concentrates was cleaned once.

Metallurgical data

Product	Weight Percent	Analysis, percent		Percent of total	
		Cu	Ni	Cu	Ni
Copper concentrate	1.4	17.8	1.12	73.4	4.1
Copper middling	5.0	.09	.74	1.3	9.7
Nickel concentrate	7.1	.34	3.59	7.2	66.5
Nickel middling	2.4	.29	.57	2.1	3.6
Pyrrhotite concentrate..	1.1	.25	1.13	.8	3.2
Pyrrhotite middling	1.0	.23	.82	.7	2.1
Tailing	82.0	.06	.05	14.5	10.8
Head, calculated	100.0	.34	.38	100.0	100.0



Flow sheet for the selective flotation of copper and nickel.

Reagent data

Reagent	Pounds per ton of feed									
		Copper			Nickel			Pyrrhotite		
	Mill	Cond.	Rougher	Cleaner	Cond.	Rougher	Cleaner	Cond.	Rougher	Cleaner
Lime	7.0	-	-	-	-	-	-	-	-	-
Potassium Ethyl xanthate	-	0.05	-	-	-	-	-	-	-	-
Reagent 238	-	.02	-	-	-	-	-	-	-	-
Cresylic acid....	-	.05	-	-	-	-	-	-	-	-
Potassium amyl....	-	-	-	-	-	-	-	-	-	-
Xanthate.	-	-	-	-	0.30	-	-	0.4	-	-
Pine oil.	-	-	-	-	.05	-	-	.05	-	-
Sulphuric acid....	-	-	-	-	-	-	-	10.0	-	-
Time minutes.	20	2	8	2	2	10	4	2	5	3

Remarks

1. Magnetic separation does not concentrate the copper or nickel to any appreciable extent.

2. Bulk sulfide flotation does not concentrate the copper appreciably, but it does concentrate the nickel (ratio of concentration, 5.4 to 1).

3. By selective flotation, 79.8 percent of the copper may be recovered as a concentrate containing 18.4 percent copper. Likewise, 66.5 percent of the nickel may be recovered as a nickel concentrate containing 3.59 percent nickel. The grade of the nickel concentrate depends upon the recovery - as one is lowered the other is increased. In one test, in which 82 percent of the nickel was recovered, the concentrate contained 1.85 percent nickel.